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Practical Strategies for Making "Grid 2030" a Reality: a Distributed Energy Resources (DER) Perspective

Subcontract Number: NAD-1-30605-11

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Presented by: Steven Greenberg

Electric Distribution Transformation Program

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Overview of this Presentation

1 Purpose of the Subcontract
2 What RealEnergy Does
3 RealEnergy's Distributed Energy Information System
4 Meeting the Challenge of the Grid 2030 Initiative
5 Lifecycle Project Timeline and Budgets
6 Contact Information
7 Questions

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Purpose of the Subcontract

The purpose of the subcontract is to fulfill the following two objectives:

- Define the state-of-the-art of optimal control, energy management and communications technologies for the integration of distributed power systems into a “virtual utility application”;

- Advance research on distributed resource markets, regulatory and market barriers, design and operational issues, communications standards and new business models that maximize the value and reduce the cost of distributed power.

RealEnergy Builds, Owns and Operates Distributed Energy Resources (DER)

To date, RealEnergy:

- Owns a portfolio of DERs, including PV and clean CHP
- Operates a total of 23 DER Systems
- Over 45 MW under contract in operation or under construction
- Generated over 35,000,000 kWh
- Captured over 2,200,000 ton-hours of thermal energy
- Developed unique enterprise-wide Distributed Energy Information System (DEIS)

RealEnergy employs onsite distributed generation/combined heat and power (CHP) technologies that:

- Generate substantial cost savings or revenues (depending on facility type and client preference)
- Provide efficient, cost-effective alternatives to facility owners/operators
- Provide clean and reliable electrical power
- Provide thermal energy (hot and chilled water)
- Provide back-up power reliability

All at no cost and no risk to building Owners/Operators.

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RealEnergy's DEIS in the "Grid 2030" Report

RealEnergy received notice in the OETD's Grid 2030 report for its work in describing its Distributed Energy Information System (DEIS)...

Integrated Distribution System

"RealEnergy of Woodland Hills, California has developed an enterprise-wide distributed generation management system that balances system integration, communications, metering, billing, monitoring, alarming, and control with equipment run-time allocations, thermal and electric storage requirements, power flows, and the real-time valuation of grid services. The system addresses the integration and management of distributed power technologies in a virtual utility structure interconnected to the grid..."

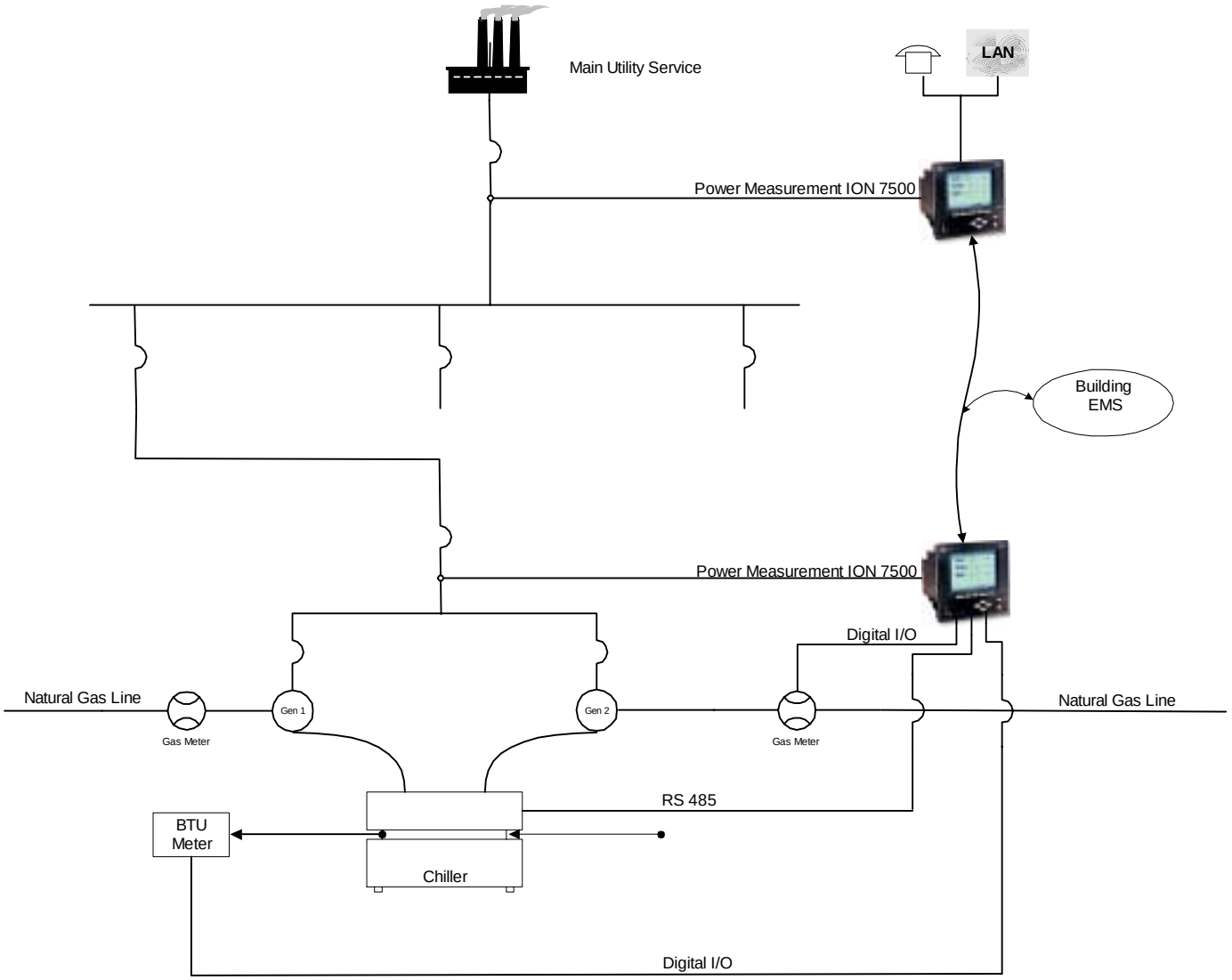
"Grid 2030" — A National Vision for Electricity's Second 100 Years, page 21

Distributed Energy Information System (DEIS)

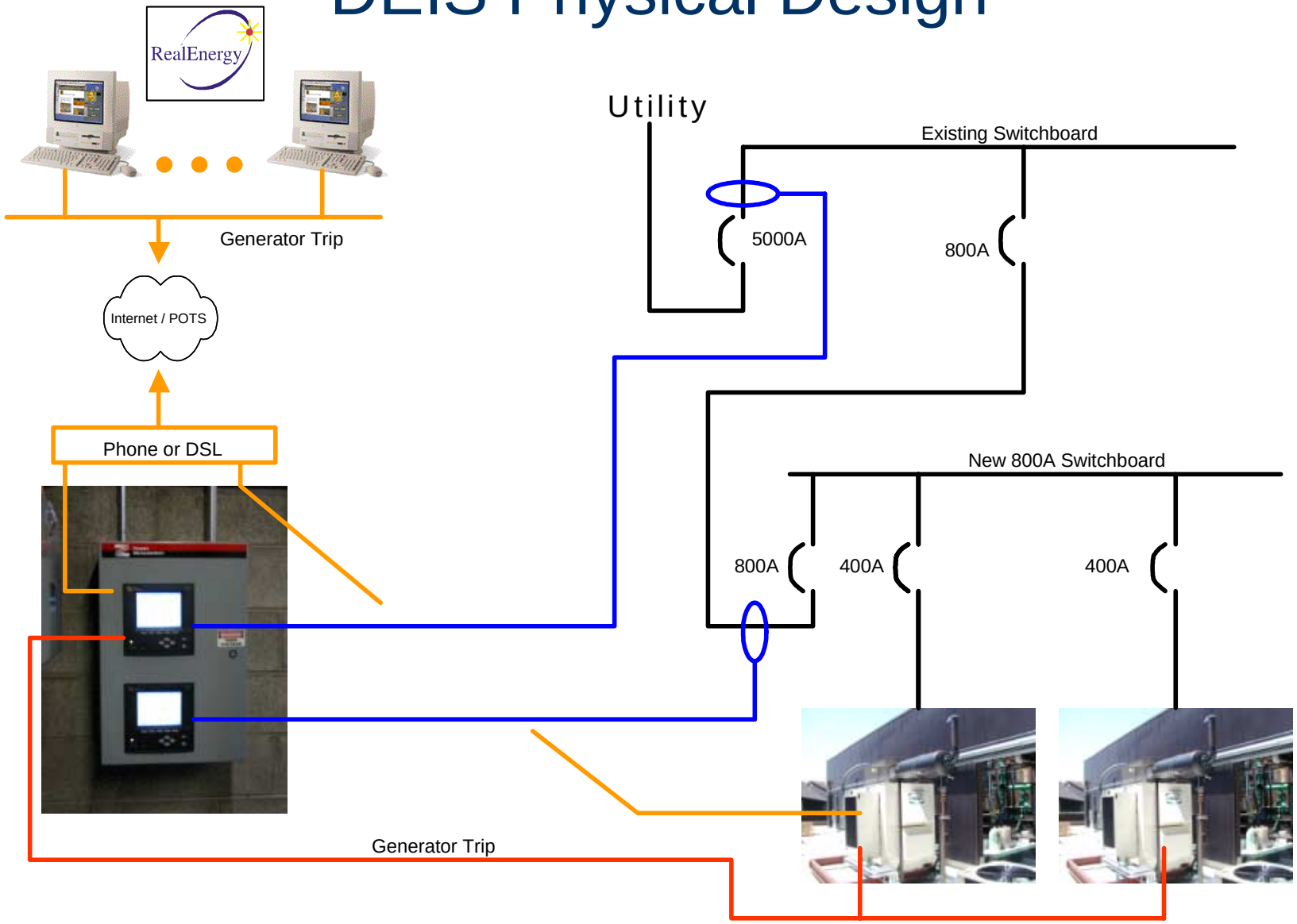
Requirements of the Network

- **DEIS controls and operates the CHP and other DER systems at a fleet of remote customer sites as a smart distribution mini-private utility:**
  - Primary Responsibilities (ICMBMAC)
    - **I**ntegration
    - **C**ommunications
    - **M**etering
    - **B**illing
    - **M**onitoring
    - **A**larming
    - **C**ontrol
  - Secondary Responsibilities
    - Analysis
    - Information Sharing (Clients, Utilities, NREL, Public)
    - New Product Evaluation
      - Cost analysis
      - Feasibility
      - Risk / Reward study

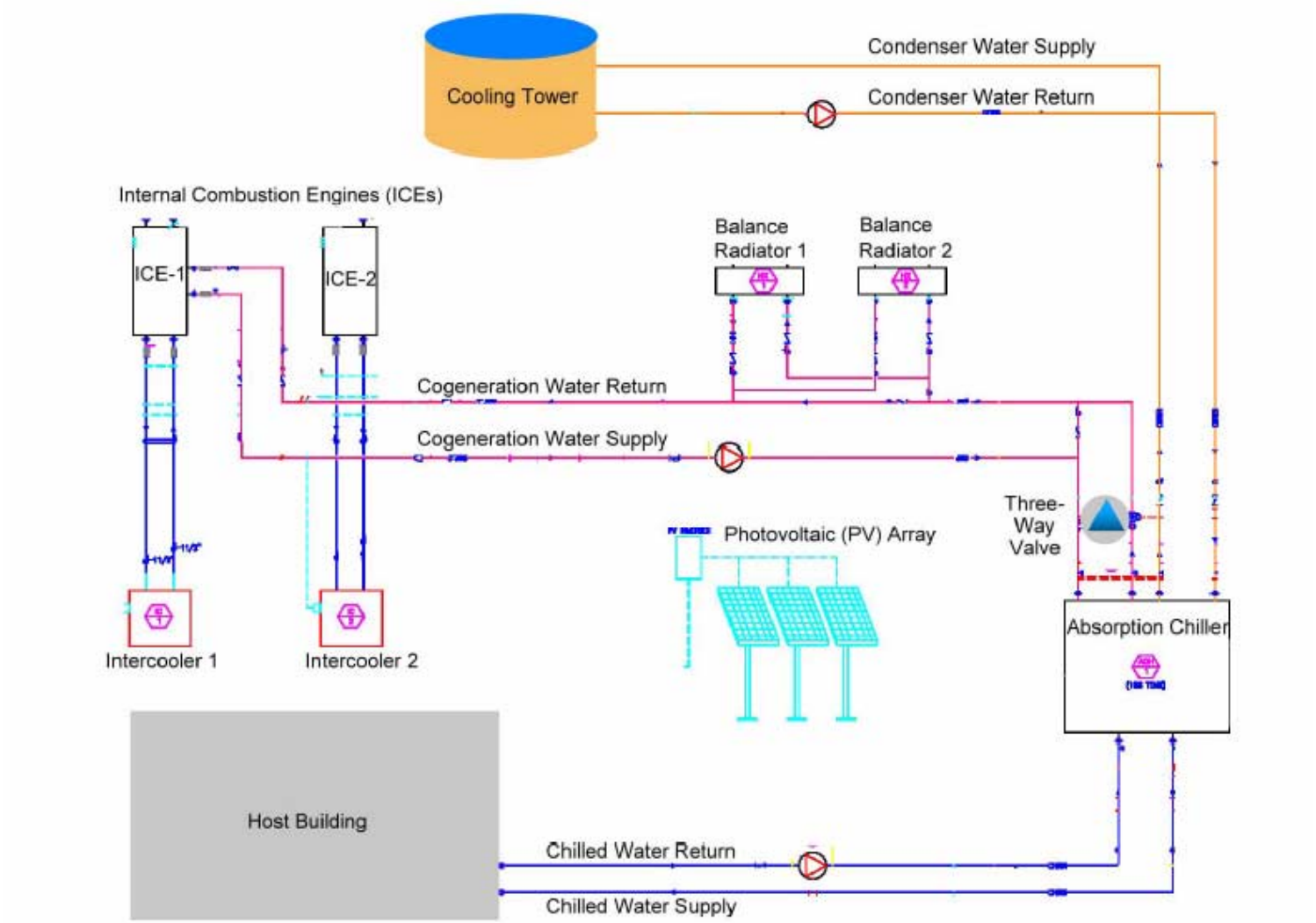
DEIS Logical Design



DEIS Physical Design



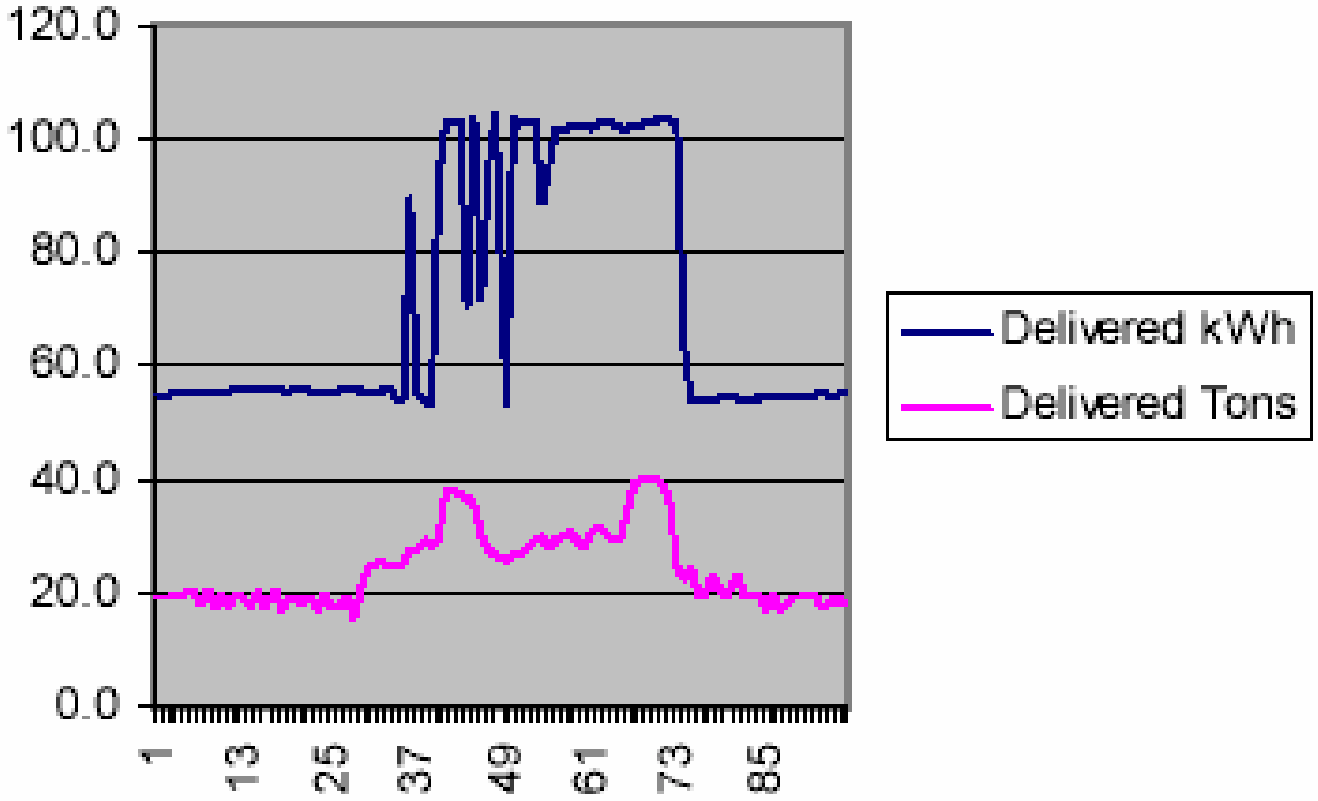
What DEIS Controls at the Customer Site



Sample Output from DEIS – 15-min. data for 1 day

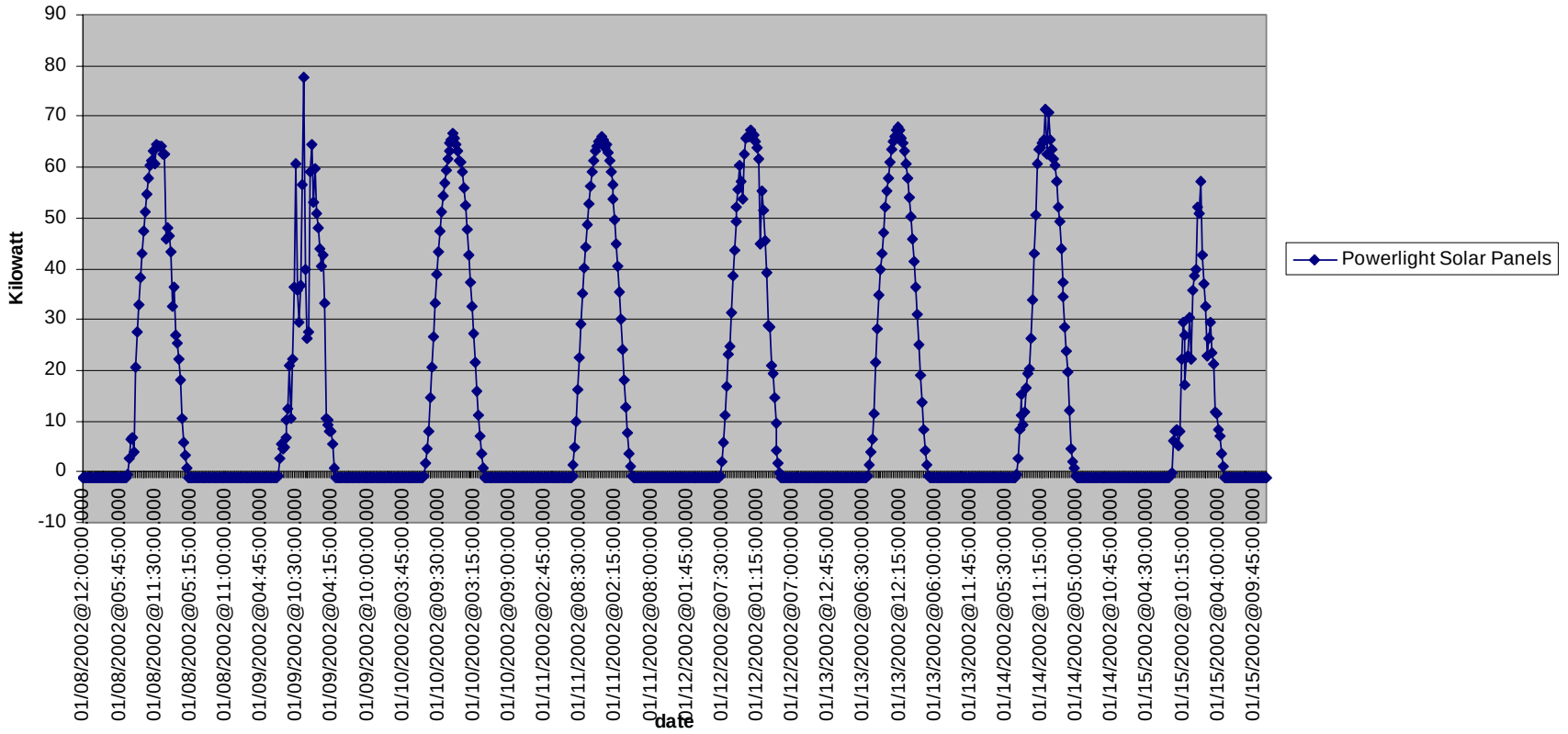
Gen Meter Output

Btu Meter Output



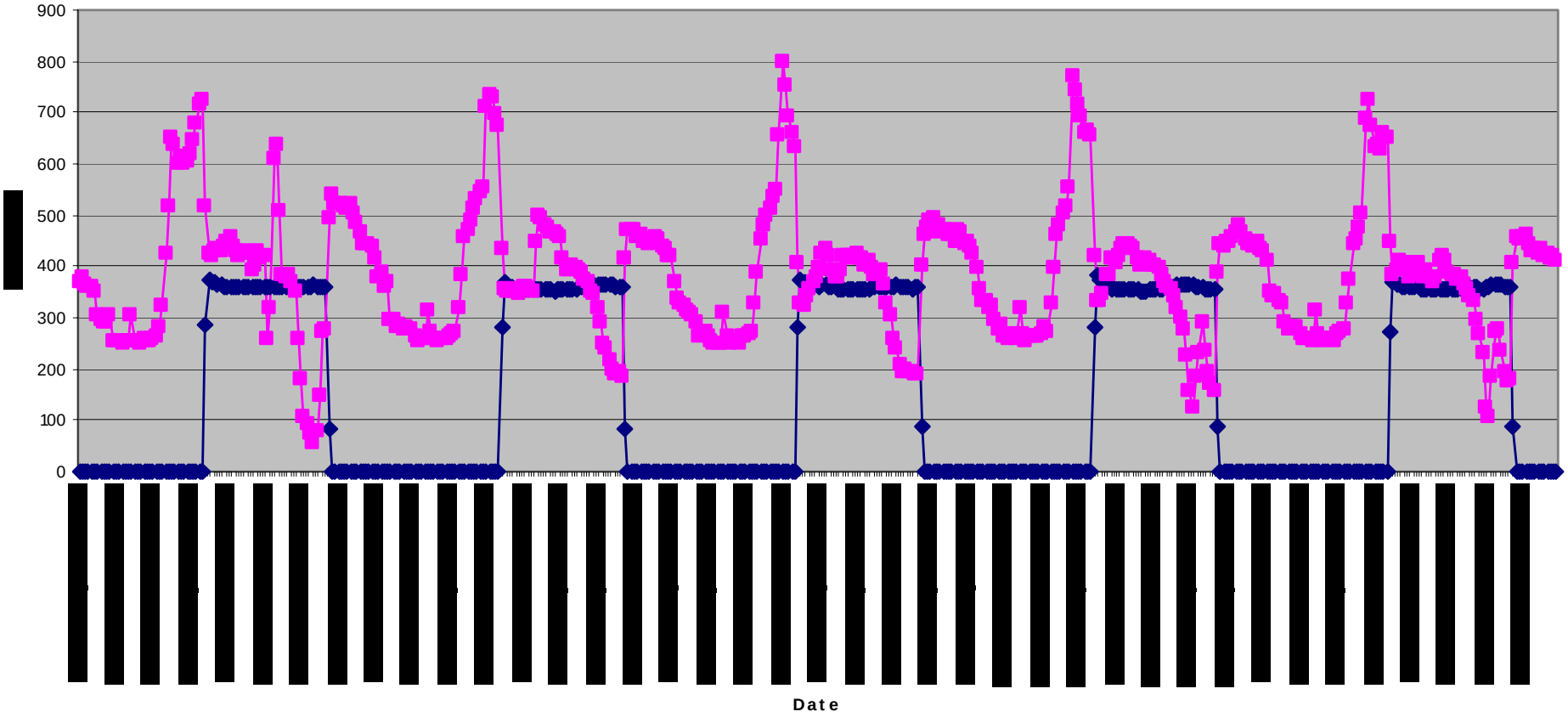
Sample Output from DEIS

Gen Meter Output from 110 kW Photovoltaic Array – 8 days



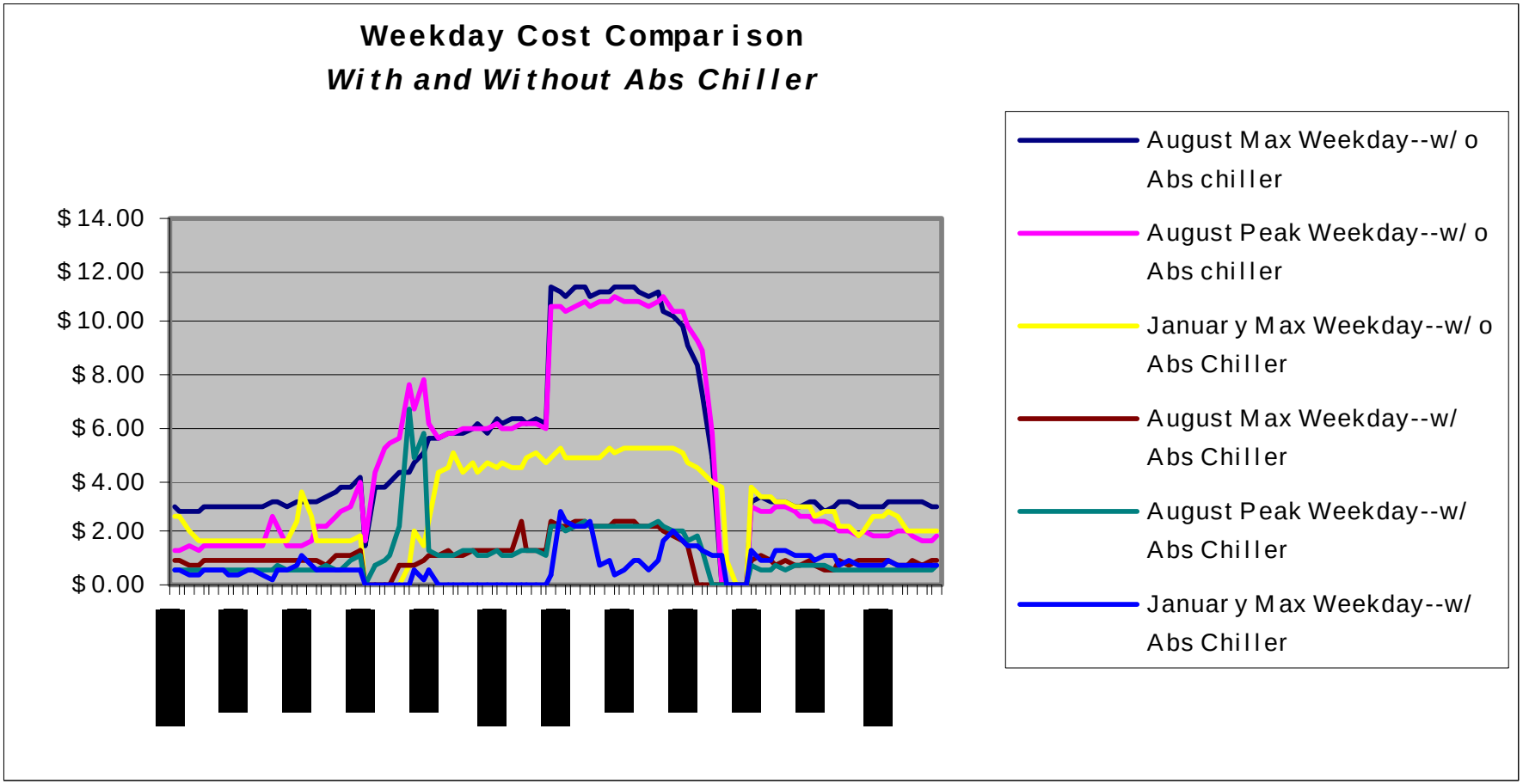
Sample Output from DEIS

Net Building Load and IC Engine Output in kW – 5 weekdays



Using DEIS Output for Analysis

Baseline & Trendline Analysis for Optimizing Economic Dispatch



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RealEnergy: Meeting the Challenge of OETD's "Grid 2030" Initiative

Deliverables address problems/needs and provide the following benefits to the primary strategic initiatives within OETD:

- Task 1: Defined Information and Communication Requirements
  - Challenge/Need : Requirements must be accommodated by design.
  - Benefit to Grid 2030: REI has defined the IT needs of a smart automated network of electric & thermal energy, lowering design costs.

- Task 2: Developed Command&Control Algorithms for Optimal Dispatch
  - Challenge/Need : System must be programmed to achieve the goal of optimal economic and operational dispatch.
  - Benefit to Grid 2030: REI algorithms automate provision of clean, flexible, reliable power at a low cost.

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Meeting the Challenge of OETD's "Grid 2030" Initiative

- Task 3: Developed Codes and Modules for Optimal Dispatch Algorithms
  - Challenge/Need: To function, algorithms must be implemented in code.
  - Benefit to Grid 2030: Resulting code modules are scalable to serve a nationwide distributed energy delivery network.

- Task 4: Test Codes Using Simulated and Actual Data
  - Challenge/Need: System must operate under real-world conditions.
  - Benefit to Grid 2030: REI's network is field-tested to provide secure and reliable power in all customer environments.

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Meeting the Challenge of OETD's "Grid 2030" Initiative

- Task 5: Install and Test Energy Management Software
  - ❖ Challenge/Need: Software/hardware platform must provide investment-grade accuracy, scalability and modularity at a low cost.
  - ❖ Benefit to Grid 2030: REI's system fulfills all network requirements of Integration, Communications, Metering, Billing, Monitoring, Alarming and Control using non-proprietary, low-cost, scalable precision devices that are both reliable and secure.
- Task 6: Contractual and Regulatory Issues
  - ❖ Challenge/Need: Define where regulatory uncertainty is a barrier to distributed energy and recommend how to overcome it.
  - ❖ Benefit to Grid 2030: Electric & thermal energy customers benefit from reduced regulatory barriers to on-site energy services.

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Meeting the Challenge of OETD's "Grid 2030" Initiative

- Task 8: Measuring Regulatory Effectiveness of Interconnection
  - Challenge/Need: For Grid 2030 to work, rules must facilitate timely, low-cost interconnection.
  - Benefit to Grid 2030: Provides feedback-for-improvement loop to technical & procedural interconnection regulations, increasing regulatory standardization and lowering installation costs.
- Task 9: Strategies in Thermal and Electrical Interconnection
  - Challenge/Need: The industry needs interconnection best practices.
  - Benefit to Grid 2030: Making best practices and improvement-loop available for use nationwide, lowering the time and cost spent "reinventing the wheel."

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- Task 10: Utility Tariff Risk and DER Market Development
  - Challenge/Need: Manage the biggest barrier: regulatory uncertainty.
  - Benefit to Grid 2030: Strategies to be developed based on analysis for adapting tariffs to reduce regulatory uncertainty and tariff risk, enabling greater investment in technology and making energy more affordable.

- Task 11: Optimizing DER Fleet Performance Through Load-Following and Auto-Dispatch
  - Challenge/Need: Need to automate dispatch decisions to achieve maximum benefit at minimum cost.
  - Benefit to Grid 2030: Technical innovations in automated fleet dispatch are essential to the operation of a smart, real-time network.

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- Task 12: DER Trend Analysis
  - ❖ Challenge/Need: Need to use information gathered to-date for constant-improvement loop to optimize future dispatch.
  - ❖ Benefit to Grid 2030: Trend analysis tools will help make DER more affordable and reliable by improving dispatch & operations.

- Task 13: Standard Information Design Hierarchy for DER
  - ❖ Challenge/Need: No information exchange standard in the energy industry, leading to balkanization.
  - ❖ Benefit to Grid 2030: Collaboration with CEIDS to produce a DER industry-standard data design hierarchy to lower costs of information exchange and integration of technologies into the system.

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- Task 14: DER Incentive Impacts
  - ❖Challenge/Need: Need to know proper incentive for DER to facilitate private investment and wide market adoption.
  - ❖ Benefit to Grid 2030: Proper DER incentive, if enacted, will make premier energy service more affordable, expanding market adoption.
- Tasks 7&15: Publicly Accessible Website
  - ❖ Reports daily operating performance of selected sites.
  - ❖ http://www.realenergy.com/dgrc/dgtech.asp

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Meeting the Challenge of OETD's "Grid 2030" Initiative

RealEnergy provides these Grid 2030 services today:

By 2010	By 2020	By 2030
Customer "gateway" for the next generation "smart meter", enabling two-way communications and a "transactive" customer-utility interface	Customer "total energy" systems for power, heating, cooling, and humidity control with "plug&play" abilities, leasable through mortgages	Highly reliable, secure, digital-grade power for any customer who wants it
Intelligent homes and appliances linked to the grid	"Perfect" power quality through automatic corrections for voltage, frequency, and power factor issues	Access to affordable pollution-free, low-carbon electricity generation produced anywhere in the country
Programs for customer participation in power markets through demand-side management and distributed generation	HTS generators, transformers, and cables will make a significant difference	Affordable energy storage devices available to anyone
Advanced composite conductors for greater transmission capacity	Long distance superconducting transmission cables	Completion of a national (or continental) superconducting backbone
Regional plans for grid expansion and modernization		

Meeting the Challenge of OETD's "Grid 2030" Initiative

RealEnergy is addressing these issues in its work with NREL today:

CHALLENGES TO ACHIEVING THE VISION

Overcoming Inertia	Attracting Resources	Developing Better Technologies	Finding Profitable Business Models	Addressing Customer and Public Needs	Developing Better Public Policies
Fragmented industry subject to balkanization	Capital investment	Unobtrusive power lines	Monetizing revenue streams	Demand-side participation in power markets	Federal-state cooperation
Embedded value of capital assets	Education, training, and development of America's workforce	Lower cost storage	Matching rewards to risks	Workably competitive market designs	Market power of incumbent suppliers
Low level of RD&D spending		Long distance superconductivity	Testing Versions 1.0	NIMBY	Public purpose programs
Attitudes resistant to change		Clean power generation			Stable regulatory framework
Slow turn-over of the capital stock		Real-time information systems			Sustained RD&D funding
Lack of success in some markets		Advanced composite conductors			

Life-Cycle Project Timeline

Milestones/Deliverables

- 2003- 11/27, Task 8: Measuring Regulatory Effectiveness of Interconnection
- 2003- 11/27, Task 9: Strategies in Thermal and Electrical Interconnection
- 2004- 01/22, Task 10: Utility Tariff Risk and DER Market Development
- 2004- 01/22, Task 14: DER Incentive Impacts
- 2004 03/25, Task 11: Optimizing DER Fleet Performance Through Load Following and Auto-Dispatch
- 2004 03/25, Task 12: DER Trend Analysis
- 2004 03/25, Task 13: DER Standard Information Design Hierarchy for DER

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Budgets

	Total ($K)	DOE/NREL	Subcontractor
Base Year (2002-2003)	$544,614	$312,738	$231,876
Option Year 1 (2003-2004)	$467,571	$300,125	$167,446
Total	$1,012,185	$612,863	$399,322

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